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P2.2025 Enhanced electron heating in picosecond relativistic laser-plasma interaction

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See the full abstract here
http://ocs.ciemat.es/EPS2019ABS/pdf/P2.2025.pdf

High power lasers with relativistic intensities above 1018 W/cm2 and pulse lengths exceeding picosecond (ps) have been developed in recent years. In over-ps laser-plasma interactions, energy slope of high-energy electrons tends to be higher than the scaling laws used in the sub-ps regime. One of the key mechanisms of such a superthermal electron generation is stochastic heating in a laser-irradiated thin foil, where fast electrons recirculate around and suffer multiple kicks from the laser field during the pulse duration [1]. The blowout of hot plasma towards the laser, which takes place under the ps laser heating [2], also enhances the multiple interactions of fast electrons with laser light. Understanding characteristics of the energy distribution resulted from the new accelerations arise in ps relativistic regime is essential for various applications for intense lasers, such as laser ion acceleration and the fast ignition.
Two-dimensional PICLS simulations had been carried out to study the ps relativistic laserplasma interaction, especially, an effect of laser focal spot size on the electron energy distribution. We find that the steady distribution is formed after ps laser-plasma interaction inside the spot area. The electrons in the case with small focal spot (2 um) are kicked only one time by the laser light, i.e. the hot electron average energy is given by the ponderomotive scaling. While in the case with large focal spot (50 um) the electrons interact with the laser light multiple time during the interaction. That makes the laser-plasma interaction stochastic and number of hot electrons are significantly increased. The details will be in the presentation.
Figure 1: Stationary electron distributions produced by laser light with different focal spots, 2, 5, and 50 μm, with the same intensity of 2 ×1018 W/cm2. The laser is continuously irradiated on a 5 μm solid deuteron target with 40nc. The
distribution is normalized with the input energy.

References
[1] N. Iwata et al, Phys. Plasmas 24, 073111 (2017).
[2] N. Iwata et al., Nat. Commun. 9, 623 (2018).

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